Method for Making A Blade Material and Blade Material Manufactured Thereby

FIELD OF THE INVENTION

The present invention relates to blade material of cooking knives and blade material of various shapes including a circular shape and, more particularly, to blade materials constituted by light alloy having a high hardness, and a manufacturing method thereof.

BACKGROUND OF THE INVENTION

In the conventional knives, such as cooking knives, circular spin blades, razor blades with various shapes, and the like, blades (cutters) are generally processed first by punching a rolled steel plate. Next, the steel plate undergoes heat treatment, hardening, grinding and sharpening in order to form the blade.

A method has been carried out to increase the hardness of the steel in conventional blades. However, there is a drawback in this method in that both the hardness and brittleness of Carbon steel increase during a quench process.

Powder sintered blades made from Tungsten Carbide (WC) powder and Cobalt (Co) powder has also been used. However, these powder sintered blades are heavy because of their high specific gravity at a value between 10 to 16 depending on the compositions thereof, such that the powder sintered blades have been limited in usage.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a blade material and a manufacturing method thereof adapted to maintain high wear resistance, high hardness, and low specific gravity by using light alloy having a high hardness.

In one preferred embodiment of the present invention, a method for making a blade material comprises the step of preparing a powder mixture having 40-80 weight % of Vanadium Carbide (VC) powder and 20-60 weight % of Co powder out of a total of 100 weight %, wherein the VC powder and Co powder have a particle diameter of 100μm or less, respectively. Then, a molded material is obtained by packing the

powder mixture into a mold and then pressing it. Finally, the molded material is sintered at below 1500°C, wherein the molded and sintered material has a specific gravity of less or equal to seven.

According to the embodiment of the present invention, the method for making a blade further comprises a step of adding Silver (Ag) powder at 0.3-3.0 weight % to the powder mixture in relation to the total weight of the powder mixture.

According to the embodiment of the present invention, the method for making a blade further comprises a step of adding Titanium (Ti) or Ti alloy powder at 30 or less weight % to the powder mixture in relation to the total weight of the powder mixture.

According to the embodiment of the present invention, the method for making a blade further comprises a step of adding a diamond particle or Cubic Boron Nitride (CBN) particle of 100μm or less at 15 or less weight % to the powder mixture in relation to the total weight of the powder mixture.

In addition, according to the present invention, there is provided a blade material which is manufactured by the above-mentioned methods.

BRIEF DESCRIPTION OF THE DRAWINGS

For fuller understanding of the nature and objects of the present invention, reference should be made to the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a plan view of a cooking knife according to an embodiment of the present invention; and

FIG. 2 is a perspective view of a rotating spin blade according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the present invention will now be described in detail with reference to the attached FIGS. 1 and 2.

A cooking knife blade 1, illustrated in FIG. 1, is formed by a manufacturing method according to the present invention which will be described later, and then is

subject to blade-plane grinding and blade-edge grinding to thereby form a blade edge 2 at the distal end of the blade 1.

Referring to FIG. 2, a blade rotatably installed at a rotating axis of a machine as a rotating spin blade 3 is formed with an insertion hole 4 into which the rotating axis is inserted. The rotating spin blade 3 is formed by a manufacturing method according to an embodiment of the present invention, and then undergoes plane grinding. Then, an outer periphery blade-edge portion 5 is formed by grinding the outer periphery of the plane part.

When the conventional Carbon steel blades are quenched, the hardness is limited to HV-820·HRA 84 as the maximum value and approximately 8.5 in specific gravity. On the other hand, WC-Co alloy having a high hardness contains HV1800 (HRA92) as its maximum value and a high specific gravity of around 10-16.

Thus, VC (Vanadium Carbide) is used as a blade material in the embodiment of the present invention. The VC having a micro Vickers HV=2600 or more is higher in hardness than that of WC. A sintered body of VC-Co is preferably used as a main ingredient of the blade material as it can have five to seven specific gravity depending on compositions thereof. The sintered body is about a half or one third in specific gravity than that of WC-Co alloy having a high hardness having a value of 10 to 16.

The blade material of the present invention is prepared through a liquid-phase sintering method like the conventional WC-Co alloy. Therefore, when a powder mixture of high hardness material VC powder and combining material Co metal powder is pressed and sintered, the Co powder is melted at a sintering temperature and the VC powder is dispersed into the melted Co in a solid state. The sintered body rapidly contracts as a result of the surface tension of Co, allowing the entire sintered alloy to be compactly formed.

A method for manufacturing the blades shown in FIGS. 1 and 2 will now be described according to an embodiment of the present invention.

The VC powder having a 100μm or less particle diameter is prepared at 40-80 weight %. Next, the Co powder having a 100μm or less particle diameter is prepared at 20-60 weight % so as to form a powder mixture having a 100 weight % by combining

the Co powder with the VC powder.

In the present invention, the VC powder and Co powder are set to 100μm or less in particle diameter, respectively. That is because if the particle diameter of the metal powder exceeds 100μm, the hardness of the sintered alloy is lowered according to the increase of the particle diameter.

Further, in the present invention, the VC powder is prepared at 40-80 weight % in the present invention because if the VC powder is less than 40 weight % in relation to the total weight of the powder mixture (that is, the content of Co powder is 60 or more in weight %), the wear resistance or hardness thereof is lowered due to the decrease of the content of VC, and at the same time, the specific gravity of the powder mixture increases due to the increase of the content of the Co powder.

If the content of the VC powder is 80 or higher in weight % (that is, the content of the Co powder is 20 or less weight %), then the VC powder increases in brittleness due to the high hardness as a result of the excessive content of the VC powder.

Next, the powder mixture of VC powder and Co powder mixed in the above ratio is packed in a mold of a desired shape and undergoes a press formation under a pressing force of 10t per square centimeter (cm^2), thereby obtaining a molded material.

The molded material is taken out from the mold and then sintered at a temperature of 1500°C or lower, preferably at 1300°C, in a vacuum furnace for obtaining the cooking knife blade 1 of FIG. 1 or the rotating spin blade 3 of FIG. 2.

The molded and sintered material prepared according to the above method has a specific gravity of approximately 6.8 when the VC powder is 40 weight % and the Co powder is 60 weight % in relation to the total weight of the powder mixture. On the other hand, the WC-Co alloy of the prior art is approximately 9.8 in specific gravity when 40 weight % of the WC powder and 60 weight % of the Co powder are mixed. Thereby, it is understood that when Vanadium powder is mixed with Co powder at the same ratio with that of Tungsten powder as the blade material, the hardness increases and specific gravity of the present invention decreases.

Alternatively, the molded and sintered material according to the embodiment of the present invention may have a specific gravity of about 5.6 when the VC powder is

80 weight % and the Co powder is 20 weight % in relation to the total weight of the powder mixture. On the other hand, the WC-Co alloy of the prior art is approximately 13.6 in specific gravity when the WC powder is 80 weight % and the Co powder is 20 weight % therein. Thereby, it is understood that when Vanadium powder is mixed with Co powder at the same ratio with that of Tungsten powder as the blade material, the hardness increases and specific gravity of the present invention decreases.

In another embodiment of the present invention, silver powder is added to the powder mixture for improving antibiosis and sanitation of the blade.

When a cooking knife or a circular spin blade of a light alloy having a high hardness is used to cut meat, vegetables or the like, a long-lasting cutting property as well as sanitation are required. Therefore, silver is added to the light alloy blade material having a high hardness for being used as a food-cutting knife.

The addition of silver ion allows an antibacterial property to be added to the blade material. Thus, the blade material can sustain a sanitary condition even if it is contaminated by blood or animal flesh since silver ion has antibacterial and self-purification properties.

In mixing the Silver (Ag) powder to the powder mixture of the VC powder and the Co powder, if the Ag powder is 0.3 or less in weight % in relation to the total weight of the powder mixture, the antibacterial function of Ag ion will be minimal. On the other hand, if Ag ion has approximately 0.3 to 3.0 weight % in the powder mixture, the antibacterial function of Ag ion will be effective. In addition, 3.0 or more weight % of the Ag ion does not affect obtaining a better antibiosis but only increases the manufacturing cost.

The Co powder serves as a matrix material for binding the VC powder by sintering of the Co powder. Thus, the Co powder can preferably be substituted by Ti powder or Ti alloy powder which similarly serves as a matrix material for binding the VC powder. Ti having a lighter specific gravity than that of the Co powder at around 4.5 can effectively reduce the specific gravity of the blade.

The Ti alloy powder refers to the Ti alloy containing 70 or more weight % of Ti, such as a Ti-15V-3Al-3Cr-3Sn (15-3) alloy (that is, 76 weight % of Ti), a Ti-6Al-2Sn-

4Zr-2Mo (6-2-4-2) alloy (that is, 86 weight % of Ti), or a Ti-6Al-4V alloy powder (that is, 90 weight % of Ti).

When the Ti powder or Ti alloy powder is added to the powder mixture of the VC powder and the Co powder, the Ti powder or Ti alloy powder should be 30 or less in weight % in relation to the total weight of the powder mixture.

When the VC powder and Co powder are sintered, the structure of the alloy can compactly be formed by being manufactured through the liquid-phase sintering method. However, since Ti or Ti alloy powder combines with the VC powder in a solid-phase sintering state, once the content of Ti exceeds 30 weight %, the benefit of liquid-phase sintering method using the Co powder can not be expected due to the excessive content of Ti.

In another embodiment of the present invention, a diamond particle or CBN particles having a particle diameter of 100μm or less are added to the powder mixture of the VC and the Co powder in order to increase the cutting capability of the blade.

The diamond or CBN particles are added at 15 or less weight % in relation to the total weight (100 weight %) of the powder mixture. Provided that the amount of the diamond or CBN particles exceed 15 weight %, the hardness of the blade material is insufficiently provided due to the excessive content of the diamond or CBN particles.

As apparent from the foregoing, there is an advantage in the present invention in that a blade of light alloy can maintain its high hardness and low specific gravity.

There is another advantage in that the blade of the present invention has less weight and equal volume to the conventional blade, contributing to a reduction of the activating power required to operate a machine as a result of the lightness in weight.